METHOD OF INJECTION MOLDING A FOAMABLE THERMOPLASTIC MATERIAL

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FIELD OF THE INVENTION

The invention relates to a plastic molding method and apparatus and it relates particularly to a type thereof particularly adapted for generating a closed cell plastic foam and for molding same. Said molding is particularly intended for, but not confined to, the molding of very large products having dimensions of the order of several feet in at least two dimensional directions.

BACKGROUND OF THE INVENTION

While the generation of plastic foam and the molding thereof has been carried out through a variety of techniques and a variety of types of apparatus for a number of years, certain limitations have existed in previous known methods and apparatus which have prevented this type of material from attaining its full potential scope of use. There is a wide range of variables which are applicable to greater or lesser degrees according to the particular job to be molded and certain ones are discussed below to illustrate at least some of the difficulties which have been encountered in the prior practice.

For example, in the previous practice, it has been common to place a gas generating medium in the thermoplastic material itself which medium will then produce gas when heated to a predetermined level. The mixture of the thermoplastic material and such gas generating material is then heated, usually by a combination of agitating and of external heating sources, but conceivably by either acting alone. The foam material is formed thereby and is formed within the plastic heating apparatus. Said material is then held under sufficient pressure to minimize the expansion of the gas and the foam, still under such pressure, is then conducted to the mold, either directly or after preliminary gathering in an accumulator. This procedure is undesirable in that at first the gas generating material is often expensive, second it may or may not be uniformly mixed throughout the granular material, and often does not generate gas bubbles uniformly within the plastic material, and third, since the gas generating material is responsive at least to some degree to temperature in controlling the amount of gas generated, and since the heating applied within the plasticizing device does not occur uniformly, the distribution of gas so generated throughout the plastic material is not uniform and hence further resulting in a foamed plastic product which is not of uniform or reliable quality.

Further, in the distribution of such plastic material from the foam generator to the mold cavity, present methods are reasonably satisfactory so long as only a single cavity mold is involved. However, where multiple cavities are involved or the cavities are separated from each other by substantial distances, then the pressure drop within the plastic material as same flows through the distribution system from one of the entrances of the mold cavity to the entrance of the next mold cavity, is often so great that the degree of filling of each mold cavity, or at least the density of material filled thereinto, is variable and it is extremely difficult

to produce satisfactory products. This is particularly difficult where the plastic to be handled is a material of high viscosity, such as ABS materials.

Accordingly, the objects of the invention include:

1. To provide a method and apparatus for foaming a thermoplastic material which will not be heat-dependent and will produce a foam of highly uniform density and with uniform and evenly distributed internal openings.

2. To provide a method and apparatus, as aforesaid, in which the gaseous material is introduced into and evenly distributed throughout the thermoplastic material while in a granular state and before the plasticating thereof.

3. To provide a method and apparatus wherein the gaseous material is distributed uniformly throughout the granular material so that it is then heated to effect plastication thereof while the gaseous material is held under sufficient pressure as to maintain itself uniformly distributed throughout the plastic material and thereby effect the formation of a desirable foam.

4. To provide a method and apparatus for producing a foamed material of uniform and accurately controllable density.

5. To provide apparatus for carrying out the foregoing claimed procedures accurately and reliably, which apparatus is of sufficient simplicity as not to be unreasonably expensive in the manufacturing procedure nor unreasonably complex to maintain in satisfactory working condition.

6. To provide apparatus as aforesaid wherein any kind of thermoplastic material may be mixed with any desired type of gas which is chemically inert and otherwise compatible therewith.

7. To provide apparatus as aforesaid wherein the distribution of the foamed plastic material is carried out at a relatively low pressure whereby to minimize the pressure losses occurring during such distribution operation.

8. To provide apparatus as aforesaid in which the plastic material so distributed may be received in a plurality of suitable injection assemblies and wherein completion of the filling of one thereof will not adversely affect the filling of others thereof.

9. To provide apparatus as aforesaid wherein the quantity to be introduced into each injection assembly is independently adjustable and a change in the adjustment of one injection assembly will not affect the amount of plastic material introduced into another injection assembly.

10. To provide apparatus as aforesaid in which the longer portion of the distribution system between the foam generating device and the mold cavity is traversed by the plastic material at a relatively low pressure.

11. To provide apparatus as aforesaid in which the portion of the distribution system traversed by the plastic material under a relatively high injection, mold filling, pressure is relatively short and of equal length.

12. To provide apparatus as aforesaid in which the molds are arranged in cooperation with the plastic being molded therein to provide sufficient force opposing separation of the mold halves to permit removal of a mold from the molding machine prior to such cooling of the part as to permit opening of the mold.

Other objects and purposes of the invention will be apparent to persons acquainted with apparatus of this general type upon reading the following disclosures and inspecting the following drawings.